Supplementary Information

Title: Improved CO_2 capture performance of CeO_2-doped CaO-based pellets: effects of particle size and steam treatment

Author: Yong Li[a], Wuhao Sun[a], Xilei Liu[a], Jian Chen[a, *], Hedan Tang[a], Youshi Li[a], Mingdi Li[a], Lunbo Duan[b, *]

[a] School of Automotive Engineering, Changshu Institute of Technology, Changshu 215500, China

[b] Key Laboratory of Energy Thermal Conversion and Control, Ministry of Education, School of Energy and Environment, Southeast University, Nanjing 210096, China

*Email: chenjian@cslg.edu.cn; duanlunbo@seu.edu.cn

Results and discussion

Figure S1 CO_2 capture performance of CaO-PO and 20Ce-CaO-PO over ten cycles in a vertical fixed bed reactor.

Figure S2 XRD patterns of 20Ce-CaO-PE-4 after steam hydration at different temperatures.

Table S1 N_2 physisorption results of fresh CeO_2-doped CaO-based pellets.

Table S2 Carbonation performance of the CaO-based pellets prepared in this study and those reported previously.

Results and discussion

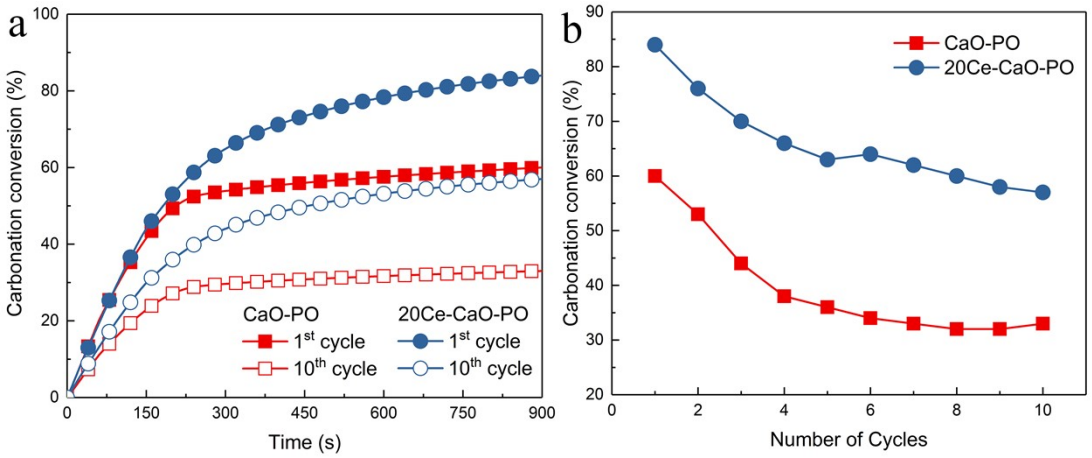

Figure S1 CO_2 capture performance of CaO-PO and 20Ce-CaO-PO over ten cycles in a vertical fixed bed reactor. (a) Carbonation conversion as a function of cycle number, (b) carbonation conversion as a function of time. CeO_2 doping significantly improved CO_2 sorption rate. Reaction condition: calcination: N_2, 850 °C, 10 min; carbonation: 15% CO_2, 85% N_2, 650 °C, 15 min.

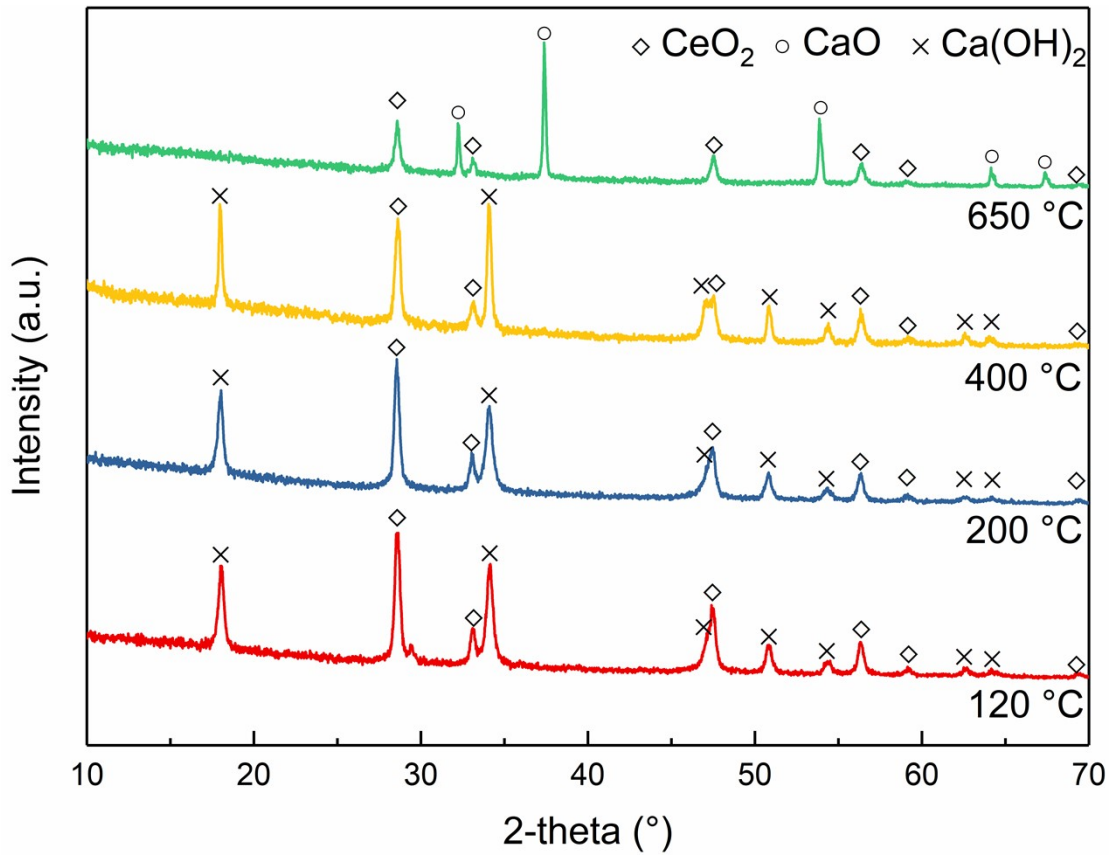

Figure S2 XRD patterns of 20Ce-CaO-PE-4 after steam hydration at different temperatures.

Table S1 N_2 physisorption results of fresh CeO_2-doped CaO-based pellets.

Sample	Specific surface area (m^2/g)	Pore volume (cm^3/g)
20Ce-CaO-PO	9.7	0.016
20Ce-CaO-PE-1	6.4	0.011
20Ce-CaO-PE-2	6.4	0.011
20Ce-CaO-PE-3	6.3	0.011
Fresh 20Ce-CaO-PE-4	6.1	0.010

Table S2 Carbonation performance of the CaO-based pellets prepared in this study and those reported previously.

Testing condition		Cycles	Carbonation conversion (%)		Ref.
Calcination	Carbonation		Initial	Final	
N_2, 850 °C, 5 min	15% CO_2, 85% N_2, 650 °C, 25 min	25	72	20	[1]
N_2, 850 °C, 10 min	15% CO_2, 85% N_2, 650 °C, 20 min	17	51.9	30.2	[2]
N_2, 900 °C, 10 min	15% CO_2, 85% N_2, 650 °C, 30 min	17	76	21	[3]
N_2, 850 °C, 10 min	CO_2, 850 °C, 10 min	30	45	30	[4]
40% CO_2, 60% N_2, 900 °C, 5 min	15% CO_2, 85% N_2, 650 °C, 30 min	25	68	29	[5]
steam, 850 °C, 10 min	15% CO_2, 85% N_2, 650 °C, 15 min	20	75.1	29.9	In this work

References:

1. Y. Zhang, X. Gong, X. Chen, L. Yin, J. Zhang and W. Liu, Performance of synthetic CaO-based sorbent pellets for CO_2 capture and kinetic analysis, *Fuel*, 2018, **232**, 205-214.
2. K. Ma, J. Sun, P. Kong, R. Sun, K. Li, Z. Zhou and C. Zhao, Core-shell structured CaO-based pellets with enhanced cyclic CO_2 capture performance, *Journal of Environmental Chemical Engineering*, 2024, **12**, 113033.
3. J. Sun, W. Liu, Y. Hu, M. Li, X. Yang, Y. Zhang and M. Xu, Structurally Improved, Core-in-Shell, CaO-Based Sorbent Pellets for CO_2 Capture, *Energy & Fuels*, 2015, **29**, 6636-6644.
4. V. Manovic and E. J. Anthony, CaO-based pellets supported by calcium aluminate cements for high-temperature CO_2 capture, *Environmental Science & Technology*, 2009, **43**, 7117-7122.
5. J. Sun, C. Liang, W. Wang and W. Liu, Screening of Naturally Al/Si-Based Mineral Binders to Modify CaO-Based Pellets for CO_2 Capture, *Energy & Fuels*, 2017, **31**, 14070-14078.